Formal aspects of computing (I) 740 (COS 740)

Qualification	Postgraduate
Faculty	Faculty of Engineering, Built Environment and Information Technology
Module credits	15.00
NQF Level	08
Programmes	BScHons Computer Science
Prerequisites	No prerequisites.
Contact time	2 lectures per week
Language of tuition	Module is presented in English
Department	Computer Science
Period of presentation	Semester 1 or Semester 2

Module content

The focus of this module is on a formal approach to deriving algorithms, known as "correctness by construction". It relies on Dijkstra's guarded command language (GCL) for specifying the derived algorithms. The requirements of an algorithm are initially stated in terms of a pre- and a post-condition, specified in first order predicate logic. Strategies are given for progressively refining these specifications to GCL notation which can, in turn, easily be translated into a conventional programming language. The surprising power of the method will be demonstrated. Not only are algorithms guaranteed to be correct (in the same sense that the proof of a mathematical theorem is guaranteed to be correct); they frequently turn out to be remarkably efficient. In the early part of the module, a number of well-known algorithms (such as linear and binary search, raising a number to an integer power, finding the approximate log of a number, etc) will be derived in order to become thoroughly familiar with the approach. Later various intermediate level algorithms will be derived (such as simple raster drawing algorithms, pattern matching algorithms, finding the longest string of a certain type, an algorithm to solve the majority voting problem, etc). Finally, the method will be used to derive state-of-the-art algorithms to minimize finite automata and to construct formal concept lattices. The theory necessary to understand these topics will be provided. The value-objectives of the module are: to develop an appreciation that theory can be effectively deployed to solve practical problems; to value the elegance of the algorithmic solutions; and to value a correctness-by-construction mindset over one that is content with debugging into correctness. A basic understanding is assumed of first order predicate logic, as well as competency in mathematical reasoning.